

ROLL

OUT THE

AIR WEAPONS ENTHUSIASTS are very fortunate with their gun barrels. We do not have to worry about leading, fouling or nickelling — and we do not even have to clean them after each shooting session. What is even better from the point of view of someone who has a small home workshop is that an air rifle barrel does not even have to be made from a highly sophisticated steel. Free cutting mild steel (EN1A) — or even brass — are excellent materials.

In the course of our air rifle experiments we needed some .22 barrels of different lengths and with different rifling patterns. This led us to experiment with drills and reamers that would give us a good clean hole straight through a length of steel with an outside diameter of half an inch.

We tried many types, including an ordinary twist drill brazed onto the end of a long rod, but they all suffered from the same problem — they did not come out in the centre of the other end. This was despite our rotating the barrel in the chuck of the lathe while holding the drill itself in the tailstock and feeding it into the bore.

After many false starts — and scraping many test pieces — we made a successful drill out of .196 inch diameter silver steel, which we hardened and tempered. This is shown on the left of *figure 1*. It is a 'D' cutter — as shown detailed in *figure 2* — but with a single spiral behind the cutting edge. This spiral collects and holds the swarf every time the cutter is withdrawn from the bore, which must be done every eighth of an inch of barrel depth. The swarf is brushed out of the spiral every time it is withdrawn and a fresh supply of cutting lubricant is injected into the barrel — all this without stopping the machine.

Although this may sound like a long and tiresome process, it actually takes only about three minutes to penetrate one inch. This may be slow when compared with an arms factory's continuous drilling with high pressure lubricant and swarf removal — but the 'D' bit was in use many years before the advent of such specialised machinery.



Figure 1. The various drills and cutters used by the authors.



Figure 2. The two cutters in detail.

You have to start the hole in the normal way when using this type of cutter. This is, you centre and drill for the first quarter of an inch or so with an ordinary twist drill. This then guides the flat faced cutter to produce a true hole.

Once the initial hole has come out satisfactorily — in the centre at the other end — it is then relatively simple to ream it out to the correct size. We found it best to use two reaming cutters: the first removes the scores left by the drill as well as the bulk of the remaining material, while the second takes out the remaining few 'thous' and leaves a fine finish. *Figure 2* shows the first cutter, and it also appears in the centre of *figure 1*. It is .213 inches in diameter and has a long cutting edge at one side to scrape the bore after the initial cutting point has

passed. It is also made from silver steel, is about eight inches long and is brazed onto the end of a piece of 3/16ths diameter mild steel.

The second cutter is similar in action to the first and is shown left of centre in *figure 1*. The main difference is that it has a small radius at the cutting point and has no scraping edge. It is made from .2187 inch diameter silver steel.

Because all the drills and cutters are quite long we have to be able to pass them right through the tailstock of the lathe. We managed this by drilling a hole through the drill chuck and its arbor. The drill rod can then be advanced into the bore by stages simply by unlocking the tailstock drill chuck.

Rifling — The Most Interesting Stage

Once you have produced a satisfactory bore, you can move on to the more interesting stage of making a barrel — rifling. It is here that any experimenter can try out his own rifling ideas, and we decided on a pitch of one turn in 12 inches. We therefore made a master spiral cut to this figure.

Making this master was the most

BARREL

with Gerald and
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tedious part of the whole project. We could not use the lathe motor when cutting such a coarse pitch, so we had to rotate the lead screw by hand, which in turn drives the spindle through suitable gearing.

Another problem was that because of its length the bar had to be turned end for end and cut in three sections that all pitched together. The finished product is shown in *figure 3* — complete with the swivelling pull handle it has in its final form. The tailstock on the lathe has had to be extended backwards to allow for the rifling of long barrels. This extension carries a peg, at the right hand end, which engages in the groove cut in the master spiral. It is this peg which causes the master bar to rotate as it is pulled through the tailstock, and the rotation is transmitted to the cutter head by the connecting pull rod. This combined action produces the required spiral groove in the barrel.

Of course, more than one groove is necessary. At the outset we did not know how many grooves we would use, so we made a dividing plate with a series of holes drilled in it, each set being on a different circle. This plate can be seen mounted on the back of a chuck in *figure 3*. It is made from a piece of plate, machined to size and then carefully divided by hand with a pair of dividers. A peg carried in the tool post is used to select the circle of holes required.

The rifling head is shown in detail in *figure 4*. It is constructed so that the cutting edge can be advanced into the grooves as the rifling proceeds — yet it can also be retracted quickly after each cutting stroke. You must be able to do this because the cutting edge will not follow the path of the already cut groove on the return stroke.

The routine for cutting the grooves then becomes a series of movements



Figure 3. The master spiral on the authors' lathe.



repeated over and over again. The cutter is threaded through the previously drilled and reamed barrel once the machine has been set up. The wedge is then inserted and the screw adjusted so that the cutter will take a small cut. The peg on the tool post is inserted into one of the selected set of holes and the cutter is then pulled through in one steady sweep.

The wedge is then removed, the cutter returned and the wedge replaced; the barrel is indexed to the next groove and another cut is taken. This procedure is repeated until the barrel has been rotated once and a first cut has been taken through each groove. The screw behind the wedge is then advanced to increase the depth of the cut, and the whole process is repeated. This is continued until the grooves are all cut to the required depth.

We made the body of the cutter head from .2187 diameter silver steel, and the long blade from a piece of high speed steel hacksaw blade. These two were silver soldered together, and the same joint was used to hold the cutter itself onto the blade. It was not at all easy to grind the cutter to shape from a piece of high speed steel because it is so small — but the final shaping can be done after the whole assembly has been joined together.

One of our reasons for going to all this trouble was that we wanted to

experiment with rifling with narrow lands. On examining pellets both after firing and while still in the barrel, we came to the conclusion that broad lands tended to hold the lead out of the grooves, thus increasing the amount of air that leaks past the pellet. There was also a tendency to increase friction. We considered that at the relatively low velocities produced by air rifles there is very little chance of the pellet stripping, so we favour narrow, sharp lands and leave the grooves wide.

Before the barrel is complete, the bore must be polished to remove the burrs thrown up by the rifling cutter. This is best done with a lead plug which is cast onto a threaded rod already in the bore. You can then guarantee that the plug fits the rifling and will polish every corner of the grooves.

This plug must not be removed until the job is finished, because it is impossible to replace it once it has been taken out. The actual polishing is carried out by moving the plug up and down the bore while it is charged with oil and fine emery powder. Great care must be taken at this stage because it is easy to overdo one area and finish up with an over-size breech or muzzle.

A section of a barrel made by this method is shown at the extreme right of *figure 1*. This shows that the rifling is even, smooth and equally divided.

Figure 4. Two views of the rifling head in detail.

